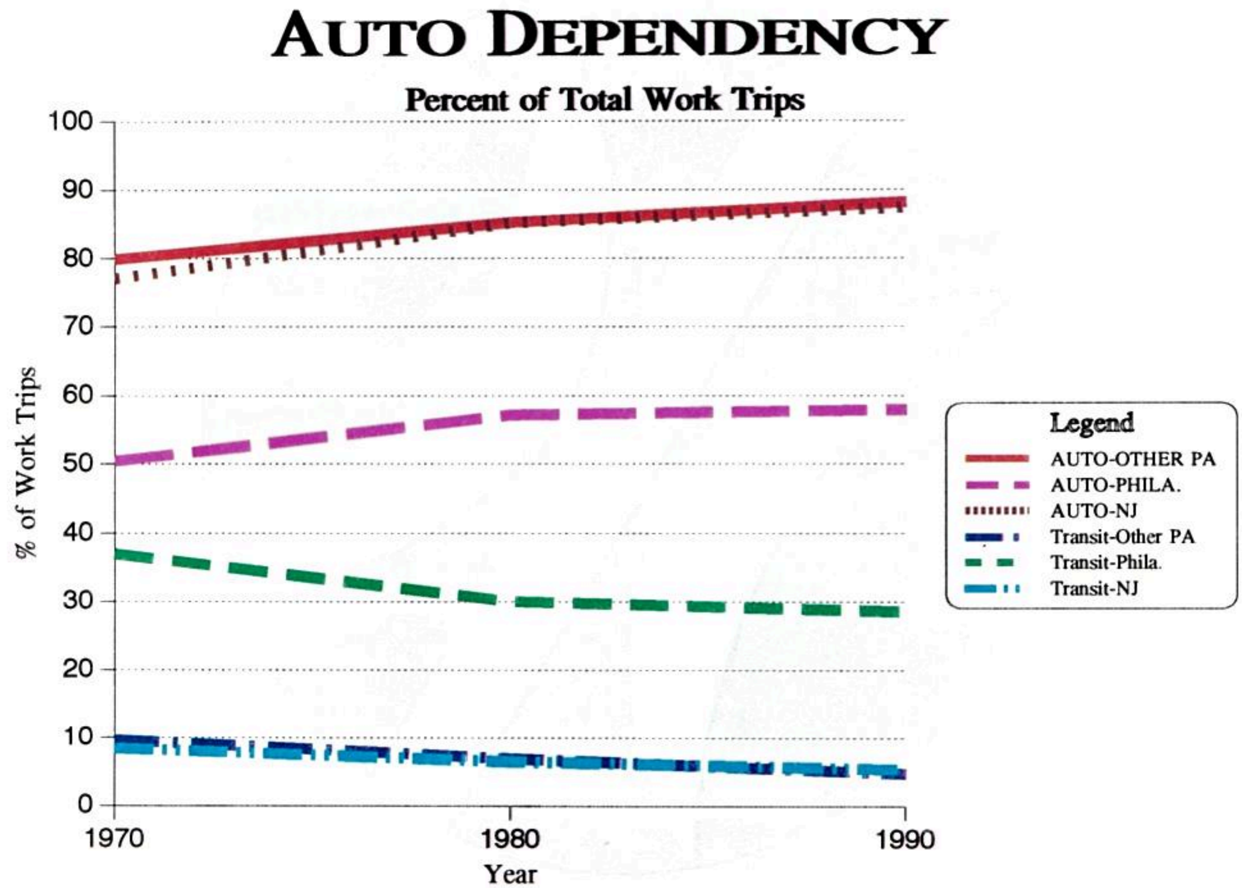
Figure 6



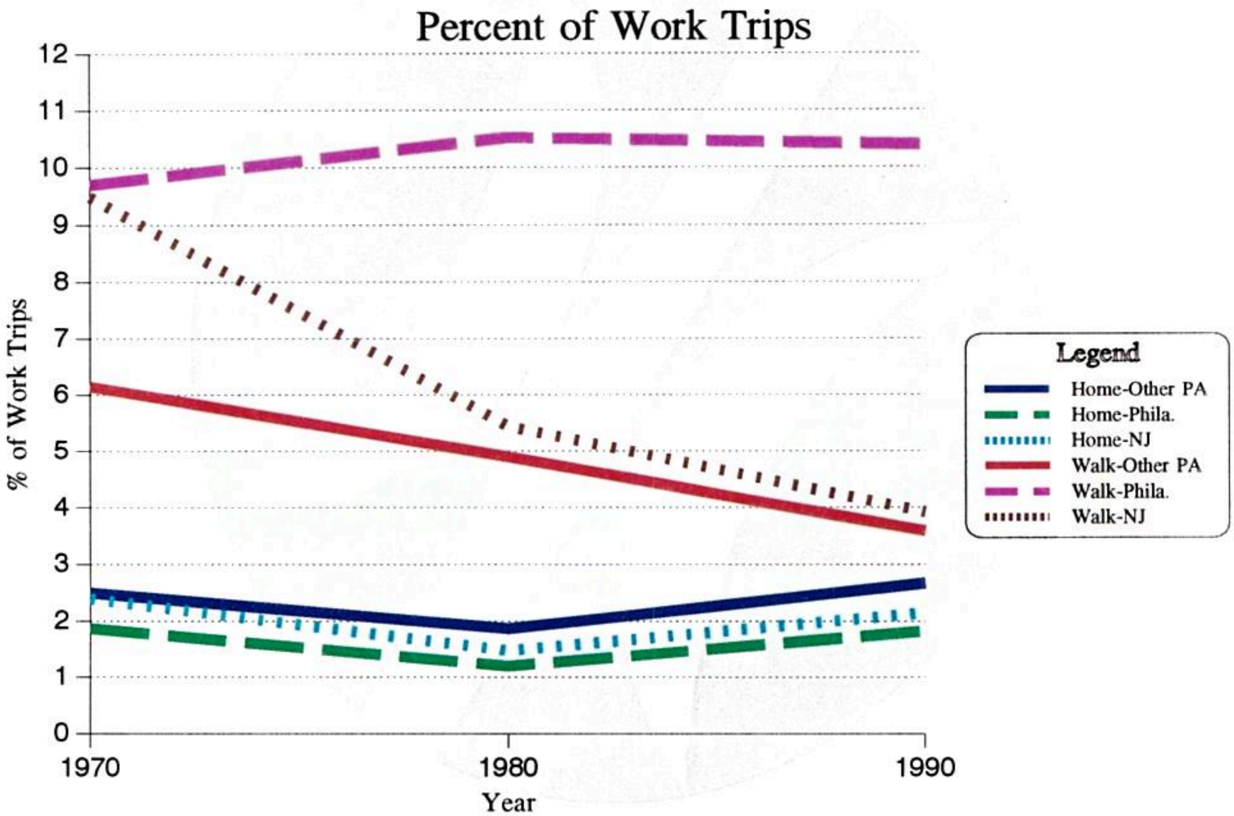
Units, Vehicle Availability and Employed Residents which details the sources used.

The City of Philadelphia has lost substantial employment during the period 1970 to 1990, while the surrounding counties have markedly increased their employment bases. There are a variety of reasons for this trend. Most significantly, manufacturing jobs in the city have declined. These job losses have been offset by job increases in the suburban counties, but most have generally been lower-paying service jobs.

This redistribution of employers to the suburbs has a threefold impact on the transportation system. First, since the existing freight rail network was largely built to serve the industrial centers of Philadelphia, Camden and Trenton, the trend increases reliance on the highway network for the shipment of goods while discouraging the use of the rail. Second, it expands the area subject to suburban sprawl development by reducing the home-to-work travel time from points at the periphery of the region. Third, it redistributes home-to-work travel patterns

Figure 7

WALK TRIPS & WORKED AT HOME



which had previously been oriented toward the region's urban centers. This makes the anticipation of long-term travel patterns more difficult to understand and collective improvement of individual home-to-work travel conditions more difficult to undertake.

Commuting Patterns

As a result of the combined impacts of decentralization of the population base within the region and the suburbanization of employment, the region has become far more automobile dependent for work trips. Even residents of Philadelphia, which remains densely populated and well served by transit, now primarily travel to work by automobile. Since fixed route transit services are poorly suited to serving widely dispersed residences and job sites, the proportion of work trips by transit has declined. Considering the extensive nature of the transit services that are provided in the region, this loss of ridership represents a growing diseconomy within the transportation system. As the transit providers struggle to maintain their existing systems, a portion of the lost revenue from lost ridership is passed on to

the remaining riders through fare increases or increases in government subsidies. Fare increases serve to accentuate this trend by further discouraging transit ridership. The graph on *Auto Dependency* illustrates that the rate of change in percentages of work trips by auto and transit modes has been relatively uniform across the entire region. In Philadelphia, these percentages have largely stabilized because of the lower rate of automobile ownership. It should also be noted that these long-term changes occurred independently of external factors such as the 1973 oil embargo, periodic transit strikes, highway openings and reconstructions. Moreover, the similar conditions in the Pennsylvania and New Jersey suburbs indicate that these trends were also somewhat independent of the nature of the fixed route transit service provided. Rather, these trends mirror the changing demographic patterns of the region and how the demand for transportation systems and services changes as a result.

Pedestrian work trips have been a declining percentage of total work trips in both New Jersey and the suburban Pennsylvania counties. (The dramatic loss—41%—of pedestrian work trips in New Jersey between 1960 and 1980 can largely be attributed to reductions in staffing at the Burlington County military installations.) At the same time, the percentage of pedestrian work trips for the City of Philadelphia has slightly increased.

Between 1960 and 1980, the number of workers who worked from their homes declined by 47%, although the absolute number is relatively small. Part of this decline in the outlying portions of the region may be a function of a general shift away from agricultural employment. This trend reversed itself in the last decade as the number of people working from home increased by 70% over the 1980 total. New technologies which allow a greater variety of work to be accomplished away from collective work sites have led to a growing segment of the workforce which "telecommutes". In addition, the changing economy has also led to an increase in self-employment which has become particularly beneficial to double-income households.

CURRENT USAGE LEVELS

Highway Usage

A wide variety of travel patterns is accommodated by the highway system in the DVRPC region. The following tables on *Highest Daily Traffic Volumes* inventory the ten most used facilities for the Pennsylvania and New Jersey portions of the region. Listed with each facility is the portion (exclusive of the Delaware River crossings) which exhibited the highest average daily traffic (ADT) in 1993. The segment of each listed highway with the highest volume is shown.

A great deal of the travel occurs on the higher-design facilities. The four most used facilities in New Jersey and the ten most used facilities in Pennsylvania are all limited access highways. Moreover, the segments cited for the fifth and sixth highest facilities in New Jersey (NJ 73 and US 1) serve as a convenient connection between limited access routes.

The region's major routes serve one or more of three possible roles. They may serve as radial routes for the well-established centers of commerce and employment in the region. These routes (such as I-95, I-76, NJ 42 and US 422) follow more or less traditional corridors of movement and connect these centers to major destinations outside the region. Other corridors (such as I-276, I-476 and I-295) are circumferential routes around these urban centers which serve to connect other destinations as well. The highest volume segments of these facilities are usually associated with the highest volume connecting facilities. Still other corridors are spurs intended to connect communitie: with the higher-design facilities. Althoug the route designations of these corridors may continue for significant distances, a higher percentage of the trips on these facilities will either originate or end in the adjacent communities. Such corridors include Woodhaven Road (PA 63) and Bethlehem Pike (PA 309).

Transit Usage

Of the region's public transit systems, the SEPTA fixed rail service is the most

Ten Highest Traffic Volumes in Pennsylvania portion of Region

	Highway	From—	To—	1993 AADT
1	I-95	Allegheny	Girard	151,100
2	I-76	Girard	Belmont	145,500
3	I-676	I-76	22nd Street	117,700
4	US 1 Expressway	Ridge	Fox	112,800
5	US 202	US 422	I-76	89,000
6	I-276	Northeast Extension	Fort Washington	83,100
7	I-476	I-76	Ridge	83,000
8	US 422	PA 363	PA 23	66,400
9	PA 63	US 13	Knights	55,900
10	PA 309	Penn	Church	55,500

Ten Highest Traffic Volumes in New Jersey portion of Region

Highway		From—	To—	1993 AADT
1	I-76	I-295	US 130	165,500
2	NJ 42	CR 544	NJ 55	100,300
3	New Jersey Turnpike	I-195	Hightstown	93,100
4	I-295	CR 561	NJ 70	88,200
5	NJ 73	NJ Turnpike	I-295	84,000
6	US 1	I-295	Lawrence	71,200
7	US 130	NJ 73	CR 616	63,400
8	NJ 70	NJ 41	I-295	54,300
9	NJ 38	Cuthbert	CR 616	53,600
10	I-676	I-76	Morgan	52,600

Fixed Route Transit System Characteristics

Property	Service	Line/Route Miles	Vehicles Available	Stations	Unlinked Trips/year
NJ TRANSIT	Commuter Rail	112	172	7	566,000
	Bus	1,291	260	0	11,816,000
PATCO	Fixed Rail	14	121	13	11,151,000
Pottstown	Bus	35	8	0	254,000
SEPTA	Fixed Rail	39	369	75	81,372,000
	Commuter Rail	282	347	155	21,238,000
	Light Rail	80	230	57	28,379,000
	Trackless	21	110	0	10,644,000
	Bus	1,377	1,441	0	156,994,000
TOTAL		**3,251**	**3,058**	**307**	**322,414,000**

heavily patronized, whether considering unlinked trips per vehicle available or unlinked trips per one-way mile. The lines are well established and serve some of the oldest, most densely developed sections of Philadelphia with a high frequency of service on dedicated right-of-way. The PATCO line into New Jersey is similarly well-patronized. The chief distinction between PATCO and SEPTA fixed rail service is that the development density along the PATCO line is not as great.

The tables on *Fixed Rail Station Usage* furnish turnstile counts for the ten most frequently used stations for both of SEPTA's fixed rail lines (the Market-Frankford and Broad Street lines) and the PATCO line. City Hall Station, a heavily used interchange between the Market-Frankford Line and the Broad Street Line does not appear in the table because transferring patrons do not pass through a turnstile. Thus, turnstile counts for that location do not represent the station's total usage.

The Market-Frankford line has the heaviest volume station and seven of the top ten. This excludes the free interchange transfers between this line and the Subway-Surface Light Rail Stations at 13th, 15th and 30th Street stations and with the Broad Street line's City Hall Station. The 15th & 16th Street platforms are closest to the most densely developed portion of Center City Philadelphia and afford an interchange point with Suburban Station, the most heavily utilized commuter rail station. The remaining top four stations on the Market-Frankford line

Fixed Rail Station Use*

SEPTA Market-Frankford Line		Avg. Weekday
1	15th Street	25,600
2	Bridge-Pratt	14,900
3	69th Street	11,800
4	8th Street	11,600
5	11th Street	8,200
6	52nd Street	8,200
7	13th Street	6,000
8	30th Street	5,500
9	60th Street	5,300
10	56th Street	4,600

SEPTA Broad Street Line		Avg. Weekday
1	Olney	19,500
2	Columbia	6,800
3	Walnut-Locust	6,000
4	Fern Rock	5,800
5	Erie	5,500
6	Spring Garden	5,300
7	North Philadelphia	4,300
8	Girard	4,000
9	Allegheny	3,800
10	Snyder	3,600

PATCO Lindenwold Line		Avg. Weekday
1	16th and Locust	7,900
2	8th and Market	6,200
3	Lindenwold	5,500
4	Woodcrest	3,100
5	Ferry Avenue	2,900
6	Ashland	2,500
7	Broadway	2,100
8	Haddonfield	2,100
9	Collingswood	1,700
10	13th and Locust	1,700

*FY 1994 Turnstile Counts

are all transfer points to other significant lines in the SEPTA system. The fourth highest location, 8th & Market Streets, is convenient to the Market East/Gallery shopping complex and affords a transfer location to both the PATCO line and the

SEPTA Regional Rail Station Use*

	Station	Line(s)	Board & Alight/Da
1	Suburban	All	18,90(
2	Market East	All	8,40(
3	30th Street	All	5,90(
4	Jenkintown	R2, 3, 5	2,40(
5	Paoli	R5	2,40(
6	Trenton	R7	2,00(
7	Temple	All	1,90(
8	Bryn Mawr	R5	1,800
9	Fox Chase	R8	1,800
10	Torresdale	R7	1,700
11	Strafford	R5	1,600
12	Wayne	R5	1,500
13	Overbrook	R5	1,500
14	Ardmore	R5	1,500
15	Lansdale	R5	1.400
16	Radnor	R5	1,400
17	Ambler	R5	1,300
18	Glenside	R2, 5	1,300
19	Narberth	R5	1,200
20	Fern Rock	R1, 2, 3, 5	1,100

*1993-94 Regional Rail Census

Broad-Ridge spur.

The largest turnstile count on the Broad Street line occurs at the Olney Transportation Center. The additional volume of passengers using the Broad-Ridge spur contribute to the turnstile counts exhibited at the Olney station and other stations between Girard and the Fern Rock Transportation Center. Olney also serves multiple bus lines from surrounding and outlying areas that meet at the recently improved station. Patronage at Olney is much higher than the Regional Rail transfer point at the Fern Rock Transportation Center. Use of the Olney station would increase further with the proposed operation of light rail vehicles on

Route 6 between Olney and Cheltenham Square Mall.

The two highest volume stations on the PATCO line are Center City stations. The 16th & Locust Street station is the station closest to the most intensely developed portion of Center City. The other station is at 8th & Market which has the same assets as the Market-Frankford station. The next two most used stations are at Lindenwold and Woodcrest, respectively. The first is the furthest station on the PATCO line at which parking is available. Lindenwold is also a transfer point to NJ TRANSIT's commuter rail line to Atlantic City. This reinforces the role of the Lindenwold station as the terminus of this line. The Woodcrest station is made highly accessible by direct ramps to and from I-295. The Ferry Avenue station provides the most convenient point of access to a number of communities south of the line via U.S. 130.

In 1983, SEPTA acquired the Pennsylvania portion of the region's commuter rail network and began the process of integrating these services into its own system. The most significant step of this process to date was completion of the Center City Commuter Tunnel and Market East station. This project made the system significantly easier to use and reduced the need to transfer between the commuter rail lines and the Market-Frankford line. Still, Suburban station remains the most heavily used station of the commuter rail system, because of its proximity to the most developed portion of Center City.

The table entitled "SEPTA Regional Rail Stations Usage" lists the 20 most used commuter rail stations in SEPTA's Regional Rail system. Eight are located on the Main Line portion of SEPTA's R5 line. The Main Line has traditionally been a strong rail commuter corridor with frequent service and high demand for station parking. Four others represent the most significant stations on the Doylestown portion of the R5 line. With the exception of the Lansdale station, all locations on this route are transfer points connecting other lines into Center City. Staggered train arrivals reduce the wait times at these locations, making the stations appealing to inbound commuters. The Lansdale station is a traditional focal point of rail activity, formerly serving as a connecting point for service to the Norristown and Telford areas. Many of the R5 trains to and from Center City terminate at this location.

Two other heavily used stations are located on SEPTA's R7 Trenton line. The Trenton station provides a transfer point between SEPTA service and NJ TRANSIT's commuter rail line to Newark and New York. A significant number of R7 passengers make this transfer because the service is less expensive than AMTRAK's direct service. The Torresdale station is convenient to park-and-ride commuters from Northeast Philadelphia via Grant Avenue. The Fox Chase station on SEPTA's R8 line is similarly convenient to Northeast Philadelphia commuters via Rhawn Street. The R7 line affords a slight time savings versus the SEPTA R3 West Trenton line, which is partially reflected by the low volumes experienced at the Rydal and Meadowbrook stations on this line.

Freight

Imported bulk cargoes account for a vast amount of total tonnage at regional port facilities. Port activity, which increased by 9% between 1992 and 1993, is subject to many factors, including international economic conditions and competition with other ports on the east coast.

During the last ten years, Philadelphia International Airport has shown steady growth in cargo traffic. Total annual tonnage enplaned and deplaned now exceeds 400,000 tons. Mail tonnage has annually increased by an average of approximately 5% since 1984, while other types of freight have increased by 12% each year.

An indication of freight rail activity in the region is provided by Ameriport, DRPA's intermodal transfer facility located near the Walt Whitman Bridge. In 1993, AmeriPort's volume increased from less than 100 lifts in January to over 3,000 lifts a month at year's end. Now, the facility supports the movement of both domestic and international containers and trailers through the Delaware Valley. Further detailing of freight movement levels in th Delaware Valley can be found in the *Intermodal Freight Plan* (DIRECTION 2020 Report No. 29).

Aviation

During the period 1980 to 1992, seven privately owned general aviation airports closed due to real estate development. Seaplane bases were deleted from the Yea 2000 Regional Airport System Plan due tc low operations levels. System capacity was reduced by 25%. During the period, demand for commercial operations increased 25%, concentrated at Philadelphia International Airport (PHL), while activity at all other airports, in the aggregate, remained constant. Nationally, privately owned airports in the FAA National Plan of Integrated Airport Systems (NPIAS) were also under pressure to close, especially in the densely populated Northeast and other areas with escalating real estate development activities. Although FAA recognizes over 5,000 airports in its NPIAS as critical to national aviation service, only 1,500 are protected from closure by public ownership or public capital investment.

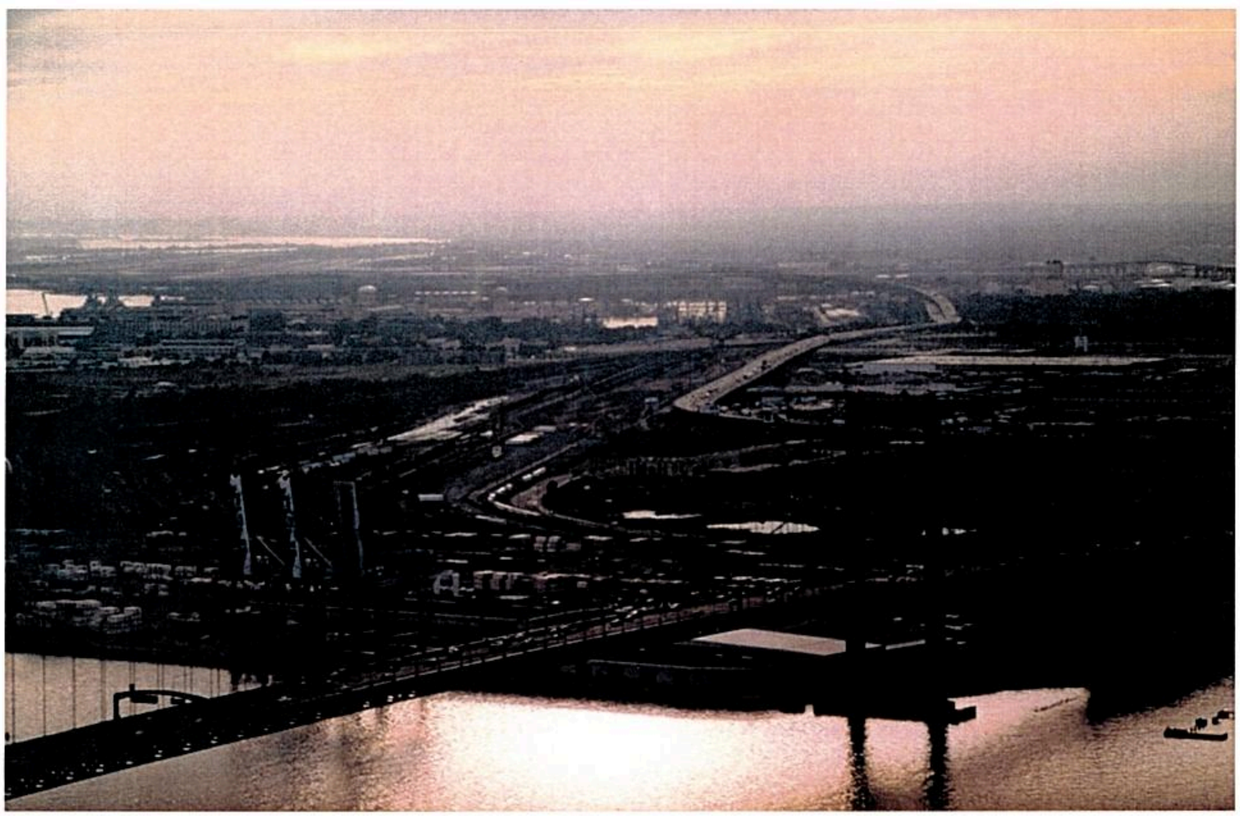
International Waterborne Commerce (in short tons)

	Exports				Imports			
	1992	1993	Change	%	1992	1993	Change	%
General Cargo	768,838	737,169	-31,669	-4%	3,995,603	4,288,093	292,490	7%
Bulk Cargo	1,541,468	1,458,295	-83,173	-5%	51,727,807	56,701,560	4,973,753	10%
Total Cargo	2,310,306	2,195,464	-114,842	-5%	55,723,410	60,989,653	5,266,243	9%

Information furnished by the Delaware River Port Authority . Examples of general cargo: fruit, steel, chemicals, paper, meat, wood, cocoa, lumber. Examples of bulk cargo: petroleum, metal ores, fertilizer, coal, gas.

Non-motorized Commuting Trends, 1980-1990

County of Residence	Walk 1980	Walk 1990	Walk Change	Bicycle 1980	Bicycle 1990	Bicycle Change	Combined Change Number	Combined Change Percent
Burlington	10,599	8,140	-23.2%	631	659	4.4%	-2,431	-21.6%
Camden	6,973	7,476	7.2%	495	595	20.2%	603	8.1%
Gloucester	3,139	2,851	-9.2%	241	267	10.8%	-262	-7.8%
Mercer	9,796	9,550	-2.5%	837	754	-9.9%	-329	-3.1%
NJ Total	30,507	28,017	-8.2%	2,205	2,275	3.2%	-2,420	-7.4%
Bucks	7,422	6,876	-7.4%	593	658	11.0%	-481	-6.0%
Chester	7,860	7,647	-2.7%	443	312	-29.6%	-344	-4.1%
Delaware	13,266	12,698	-4.3%	649	635	-2.2%	-582	-4.2%
Montgomery	15,581	11,920	-23.5%	1,081	607	-43.8%	-4,135	-24.8%
Philadelphia	63,615	66,446	4.5%	2,516	3,637	44.6%	3,952	6.0%
PA Total	107,744	105,587	-2.0%	5,281	5,849	10.8%	-1,589	-1.4%
TOTAL	**138,251**	**133,604**	**-3.4%**	**7,486**	**8,124**	**8.5%**	**-4,009**	**-2.8%**



Packer Avenue Marine Terminal

Bicycle and Pedestrian Traffic

The Census provides some insight into the levels of bicycle and pedestrian work trips generated in the DVRPC region between 1980 and 1990 as well as recent trends. Walking to work is a far more prevalent activity than bicycling, though less so in 1990 than in 1980.

In 1990, 16 times as many commuters walked as bicycled to work. In 1980, 18 times as many commuters walked. The net effect of this trend for both modes, however, has been a 2.8 percent loss in bicycle and pedestrian trips. The gains in bicycle commutation relative to walking may indicate that a greater acceptability of bicycle use by employers and employees. At the same time, the growth in both residential and employment development in outlying areas has increased employment trip lengths, contributing to the net decline in overall non-motorized commuting.

As one might expect, the greatest gains in both pedestrian and bicycle travel in the region were effected in Camden and Philadelphia counties, which include communities oriented to walking and bicycling. No other county exhibited growth in its number of walk commute trips.

Although the focus of this assessment is walking and bicycling as transportation options for commuters, the use of bicycles is broad and includes recreation and other casual trips such as shopping, running errands and other personal business trips. These uses are not addressed in this section because of limited information about the extent to which the region's population uses bicycles for these purposes. □

V PROJECTED TRENDS

MODEL CHARACTERISTICS

Travel Forecasting Model

DVRPC employs a computerized travel forecasting process to simulate and project the use of highway and transit facilities in the region. This model is driven by regional socio-economic data and transportation facilities and operating conditions.

Regional Socio-economic and Transportation Data

In the travel forecasting model, the region is divided into relatively homogeneous small areas called "traffic zones". Traffic zones are intended to serve as small aggregations of residences, employment and commercial centers, and other types of development between which trips take place. In this regard, trips are "generated" based upon the extent of the development within the zones. Equations are used to convert these socio-economic parameters into daily trips. Within the DVRPC region, traffic zones are delineated for the entire nine county area and roughly follow the block group and tract boundaries of the Census. For the purposes of simulating the travel conditions in the year 2020, data is disaggregated into 1,335 traffic zones. The types of information collected and projected at the traffic zone level include:

- Population
- Employment by standard industrial classification (SIC) group
- Employed residents
- Number of households, stratified by numbers of cars available (0,1,2,3+)
- Total automobiles

The year 2020 population and employment projections were obtained from the DVRPC *Year 2020 County and Municipal Interim Population and Employment Forecasts* adopted in June 1993. The projected number of households in each zone was based upon the extrapolation of county level trends in the average size of all households. The projected number of employed persons per zone was based upon the application of a factor to these total household figures. The auto ownership data was based upon the stratified household information from the Census, and projections were based upon the historic trends.

In addition to trips generated within the zones, two other kinds of trips must be considered: trips that have one end outside the region and one end within the region; and, trips which pass through the region, where both the origins and destinations are points outside the region. Both types of trips are distributed based upon cordon line survey results. There are 113 highway crossings of the region's boundary (cordon line) where such trips occur.

Transportation facility characteristics are also important to the model. Highway characteristics control the flow of traffic along a facility. Important characteristics include: length, uncongested travel speed (or time), hourly capacity, number of lanes, functional classification (e.g., freeways, arterials, local roads) and area type (i.e., CBDs, urban, suburban, and rural areas). Other specialized characteristics may be employed for particular situations, such as one-way streets or toll facilities.

Similarly, transit characteristics govern the ability of these facilities to convey passengers. It is recognized that for those trips where auto as well as transit and/or other modes are viable options, different types of transit modes hold different levels of appeal. These are based on various factors some of which are difficult to quantify. The computer model distinguishes between each travel mode to allow for these ridership tendencies to be considered.

Model Characteristics

The DVRPC travel simulation process follows the traditional four-step methodology: trip generation, trip distribution, modal split and travel assignment. DVRPC employs the battery of computer programs developed by the US DOT for travel simulation, the Urban Transportation Planning System (UTPS). Staff has worked with these programs over the last two decades, refining some of the component models and calibrating them to the Delaware Valley region. These models are explained briefly below. A complete description of the simulation and model structure can be found in the DVRPC publication *Testing and Adjusting DVRPC Travel Simulation Models with 1980 Census Data*, September 1985. Tl models have been subjected to a preliminary validation using 1990 Censu data and updated traffic counts.

Trip Generation—Trip generation is the first step in the modeling process. Persc truck and taxi trips are generated from traffic zone estimates of households and employment through the use of trip rates disaggregated by trip purpose (home bas‹ work, home based non-work, non-home based), auto ownership and area type. Estimates of external and through highwa and transit trips are developed from population and employment estimates in counties surrounding the Delaware Valle) region.

Trip Distribution—Trips from traffic zone within the region are allocated to destinations within the region with a "gravity" model. This model assumes tha the propensity to travel to a destination zone increases with the attractiveness of the destination (as measured by employment) and decreases as the difficulty of traveling between zones increases. This limitation is measured by travel time and cost for both the highway and transit modes.

Modal Split—The modal split model divides the trips between the region's traffic zones into transit and highway components. Generally, the tendency to use public transit increases with the relative transit-to-highway service levels. The relative service levels are estimated through highway and transit out-of-vehicle time and in-vehicle time; highway operating costs and parking charges; and transit fares. In addition, auto ownership, type of transit service, household income, trip purpose and the consumer price index further define the trip-maker's choice between highway and transit.

The modal split model also determines the average number of persons per automobile. This value is used to convert auto person trips to auto vehicle trips. Auto occupancy is estimated as a function of trip purpose and trip length.

Travel Assignment—The final step in the process assigns the estimated highway vehicle and transit person trips to specific facilities. This is accomplished by determining the best (i.e., minimum time and cost) route through the highway and public transit networks and allocating the transit trips to the transit facilities and highway trips to the highway facilities. Highway capacity is "restrained" in that congestion levels are considered in determining the best route.

Significant amounts of vehicular trips also occur on local streets not included in DVRPC's regional highway network. For purposes of calculating mobile source emissions, this "off-network" vehicle miles of travel (VMT) was estimated separately by county based on the mileage of missing streets and an average off-network travel volume. For the region as a whole, it is estimated that 11.4 percent of VMT occurred on local streets in 1990.[1]

Highway Source Emissions Modelling

Highway source emissions analysis must be performed on a regular basis for the Philadelphia nonattainment area. The estimation of regional emissions requires many inputs. These factors include population and employment estimates and forecasts, and travel data, including auto and transit trip volumes and auto speeds. Composite emissions factors, derived from the model MOBILE5a are applied to highway vehicle travel data to estimate three types of emissions: volatile organic compounds (VOCs), oxides of nitrogen (NO_x) and carbon monoxide (CO).

Average Daily Highway Operating Speeds

Emission factors calculated by MOBILE5a vary significantly with vehicle operating speed. For this reason, the amount and distribution of the mobile source pollutants are influenced by the accuracy and sensitivity of the method used to convert travel model measures of highway congestion into operating speed. For this analysis, a complex set of curves is used to estimate operating speed. These curves were taken from a report prepared by Creighton, Hamburg, Inc. for the FHWA.[2]

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[1] *Conformity of the Delaware Valley's FY 1994 Transportation Improvement Program*, DVRPC, August 1993, p. 20.

[2] Creighton, Hamburg, Inc. *Freeway-Surface Arterial VMT Splitter.* Federal Highway Administration, Washington, D.C., 1971, pp. 22-24.

A separate set of curves is used for freeways and arterials. The freeway curves relate peak hour operating speed to the speed limit, capacity and peak hour simulated vehicular volume. The arterial curves relate peak hour speed to the speed limit, capacity, traffic signal density (per mile), free flow speed and the peak hour simulated volume.

Peak hour volumes are estimated from simulated daily volumes taken from traffic counts through the use of a peak hour percentage (determined by functional class of the road and area type). Speed limits, signal densities, and free flow speeds were input as a look-up table by functional class and area type. DVRPC travel time surveys have found that daily speeds are on average about 10 percent higher than peak hour speeds.[3]

The speeds from the curves have been validated with available travel time survey data. Additionally, the freeway curve required the addition of a minimum speed of 8 to 10 mph (depending on area type) to the Creighton, Hamburg formulation to adequately replicate DVRPC's travel time survey data.

Estimation of Mobile Source Emissions

Using computerized software developed for the TIP Conformity Process, mobile source emissions are calculated based on simulated VMT and speed data (rounded nearest mile per hour) from the 1996, 2005, 2015 and 2020 highway assignments. Emissions for individual roadway segments are calculated to reflec the appropriate set of MOBILE5a emissions factors. These emissions are then aggregated to county and state totals

VMT projected to occur on local streets not included in the regional network is estimated independently. Prior to calculating emissions, off-network VMT i apportioned to five-kilometer grid cells based on the distribution of network VMT Simulated travel speeds on included local streets are used as a proxy for speeds on excluded links. Emissions are then estimated for five kilometer grid squares and summarized by state.

Emission factors produced by the MOBILE5a computer program vary significantly depending on the settings of various policy and climatic options. Thes are included in order to tailor the output t both meteorological conditions and state and local emissions control programs. Emissions factors must be calculated for both Pennsylvania and New Jersey, as inspection procedures and fuel vapor recovery systems vary. For purposes of testing *Moving People and Goods*, the required sets of MOBILE5a parameters were developed as a cooperative effort between the staffs of the Pennsylvania Department of Environmental Resources, New Jersey Department of Environmental Protection and Energy, and EPA regions II (New Jersey) and III (Pennsylvania).

[3] *Conformity of the Delaware Valley's Transportation Improvement Program*, DVRPC, August 1993, p. 20.

3ased on these parameters, the MOBILE5a omputer program is used by DVRPC to repare separate emissions factor tables ppropriate for the years 1996, 2005, 2015 nd 2020. For each forecast year and ollutant, the emission factor table consists of 53 speed entries, calculated by whole nile-per-hour increments from 3 to 55 nph. These factor tables are then used to stimate emissions for each highway etwork alternative using the emissions calculation procedure.

PROJECTED CONDITIONS

n order to quantify the impact of *Moving People and Goods* on mobile source emissions, DVRPC's travel simulation nodel was run eight times. Separate *trend* and *plan* (i.e., no-build and build) runs were executed for the years 1996, 2005, 2015 and 2020. Plan runs incorporated changes to the highway and transit networks based on most of the facility recommendations found in Chapter VII. Additional air quality benefits are anticipated to accrue owing to policy and additional facility recommendations that are beyond the present capabilities of the computer analysis.

Between 1990 and 2020, trend travel projections show the implications of continuation of the previously discussed changes to residential and employment distributions. Further disbursement of home and work locations will further tax the region's network of highways as automobile trip making increases. The recommendations of the plan address these trends through the integrated programming of transportation improvements which encourage shared-ride alternatives for work trips and other means to reduce congestion and improve mobility.

The table on the next page summarizes the effects of implementing the plan upon transit, driver and vehicle trip-making in the region. In all three cases, the benefits of the modelled facility recommendations upon travel patterns can be seen.

Transit trip origins were obtained for the region given (a) projected transit services, (b) regional demographics and (c) the modelled mode choices of individuals. One transit trip origin occurs for each trip between two locations via transit, regardless of the number of transit vehicles boarded en route. Over this time period, trend conditions point toward a slight decline (2.7%) in transit ridership. Selective expansion of the system, through new and more frequent services and new facilities, reverses this decline. The net effect is a 4.7% increase in ridership over the trend condition which translates into an additional 40,000 transit riders per day. Automobile driver trip-making is anticipated to increase 23.1% over the 1990 to 2020 period under trend conditions. On the other hand, the regional population and employment growth rates are only projected to be 9.9% and 20.0%, respectively. The expansion of transit services, particularly in presently unserved areas and the improved integration of existing services diminishes this increase slightly. The net effect is a 0.2% decline, or roughly 26,000 fewer

Projected Trips per Day (Thousands)

		1990	1996	2005	2015	202
Transit	Trend	859	851	843	842	83
	Plan	859	851	847	872	87
Driver	Trend	10,971	11,586	12,362	13,167	13,50
	Plan	10,971	11,586	12,359	13,149	13,47
Vehicle	Trend	14,052	14,906	16,006	17,084	17,53
	Plan	14,052	14,906	16,003	17,066	17,51

automobile driver trips per day with implementation of the modelled changes. This impact is not as great as the aforementioned transit ridership gain owing in part to improved automobile access to the transit system.
The increase in total vehicle trips reflects the above change in automobile travel. The total vehicle trip parameter is intended to more closely replicate the amount of travel that is actually occurring on the region's roadways. It includes truck traffic, taxi trips and additional trips across the regional boundary.

As travel destinations become more scattered throughout the region, it might be assumed that the number of miles travelled for the average vehicle trip will increase over time. This means that the number of vehicle-miles travelled can be expected to increase faster than the numbe of vehicle trips made, and indeed this is what is projected to occur.

Under trend conditions, total VMT within the region is projected to increase 33.2% between 1990 and 2020. (VMT is calculated for a typical summer day for the purpose of estimating emissions which cause ozone.) The increase is relatively

Projected Vehicle Miles of Travel per Summer Day (Thousands)

		1990	1996	2005	2015	2020
Trend	New Jersey	34,443	36,068	40,305	44,121	45,600
	Pennsylvania	64,565	70,195	77,762	83,829	86,313
	REGION	99,008	106,263	118,067	127,950	131,913
Plan	New Jersey	34,443	36,068	40,277	43,814	45,321
	Pennsylvania	64,565	70,195	77,534	83,480	85,983
	REGION	99,008	106,263	117,811	127,294	131,304